Chapter 10 - Quality Assurance

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Chapter Highlights

Quality assurance and quality control programs are maintained by contractors conducting environmental monitoring, and by laboratories performing environmental analyses to ensure precise, accurate, representative, and reliable results, and maximize data completeness. Data reported in this document were obtained from several commercial, university, government, and government contractor laboratories. To assure quality results, the laboratories participate in a number of laboratory quality check programs.

All laboratories used by the Environmental Surveillance, Education and Research Program met their quality assurance goals in 2003. Quality issues that arose with laboratories used by the Management and Operating contractor were addressed with the laboratory and resolved.

10. QUALITY ASSURANCE

Quality assurance and quality control programs are maintained by contractors conducting environmental monitoring and by laboratories performing environmental analyses.

10.1 Quality Assurance Programs

The purpose of a quality assurance and quality control program is to ensure precise, accurate, representative, and reliable results, and maximize data completeness. Another key issue of a quality program is to ensure that data collected at different times are comparable to previously collected data. Elements of typical quality assurance programs include, but are not limited to the following (ASME 2001, ASME 1989, EPA 1998)

- Adherence to peer-reviewed written procedures for sample collection and analytical methods;
- Documentation of program changes;

- Periodic calibration of instruments with standards traceable to the National Institute of Standards and Technology (NIST);
- Chain of custody procedures;
- Equipment performance checks;
- Routine yield determinations of radiochemical procedures;
- Replicate samples to determine precision;
- Analysis of blind, duplicate, and split samples;
- Analysis of quality control standards in appropriate matrices to test accuracy;
- Analysis of reagent and laboratory blanks to measure possible contamination occurring during analysis;
- Analysis of blind spike samples (samples containing an amount of a constituent known to the sampling organization, but not the analytical laboratory) to verify the accuracy of a measurement;
- Internal and external surveillance to verify quality elements; and
- Data verification and validation programs.

10.2 Laboratory Intercomparison Program

Data reported in this document were obtained from several commercial, university, government, and government contractor laboratories. In 2003, the Management and Operating (M&O) contractor used the Idaho National Engineering and Environmental Laboratory (INEEL) Radiological Measurements Laboratory (RML) and General Engineering Laboratories (GEL) for radiological and inorganic analyses. The M&O Drinking Water Program also used Paragon Analytes, Inc. and for radiological analysis and Microwise Laboratories of Idaho Falls for bacteriological inorganic analysis; and Environmental Health Laboratories for organic analyses.

The Environmental Surveillance, Education and Research (ESER) contractor used the Environmental Assessments Laboratory (EAL) located at Idaho State University (ISU) for gross radionuclide analyses (gross alpha, gross beta, and gamma spectrometry) and Severn-Trent Laboratories (STL) of Richland, Washington, for specific radionuclide analyses (e.g., strontium-90 [^{90}Sr], americium-241 [^{241}Am], plutonium-238 [^{238}Pu], and plutonium 239/240 [$^{239/240}$Pu]). The U.S. Department of Energy's (DOE's) Radiological and Environmental Sciences Laboratory (RESL) performed radiological analyses for the U.S. Geological Survey (USGS). The USGS National Water Quality Laboratory (NWQL) conducted nonradiological analyses. For 2003, samples from the Naval Reactors Facility were sent to STL of Richland, Washington, for radiological analyses and the University of Georgia for tritium analyses. All these laboratories participated in a variety of programs to ensure the quality of their analytical data. Some of these programs are described below.

Quality Assessment Program

The Quality Assessment Program, administered by the DOE Environmental Measurements Laboratory (EML) in Brookhaven, New York, is a performance evaluation program that tests the quality of DOE contractor and subcontractor laboratories in performing environmental radiological analyses. EML prepares samples containing known amounts of up to 15 radionuclides in four media: simulated air filters, soil, vegetation, and water. These are distributed to participating laboratories in March and September. Participants can use any method for the analysis, and they are required to report their results within 90 days. EML issues quality assessment reports twice per year in which the identities of participating laboratories, their results, and comparison to EML results are presented. These reports are available, along with a searchable database of past results, on the Internet at http://www.eml.doe.gov/qap/reports/ (DOE 2003).

2003 Quality Assessment Program Results

Comparisons of the air and water results for the laboratories used by INEEL environmental monitoring organizations in 2003 are presented in Figures 10-1 and 10-2. For the June air analysis, the DOE EML qualified the ^{241}Am and ^{137}Cs results from RML, Paragons' ^{238}Pu, and STL's uranium-234 (^{234}U) as acceptable with warning. STL also received a "not acceptable" rating on its ^{90}Sr analysis. For December, only General Engineering Laboratories received an "acceptable with warning" on its gross beta analysis. STL received another "not acceptable" rating on its December ^{90}Sr analyses.

Water results were qualified by the DOE EML for at least one constituent for all labs used. General Engineering Laboratories received an "acceptable with warning" for its June ^{134}Cs analysis and its December ^{90}Sr and ^{241}Am analyses. STL received an "acceptable with warning" in June for ^{137}Cs, ^{238}Pu, ^{239}Pu, and ^{90}Sr, and on its December ^{234}U analysis. It also received a "not acceptable" for its ^{90}Sr analysis in December. Paragon received a "not acceptable" rating for its gross alpha in June and improved to "acceptable" in December. The INEEL RML received an "acceptable with warning" for its June gross alpha and plutonium analyses (^{238}Pu and ^{239}Pu), and ^{234}U and uranium-238 analyses in December. The ISU EML received "acceptable with warning" for ^{134}Cs in both June and December and gross alpha in December.

The NWQL performed three duplicate tests for gross alpha and gross beta in June only. One test for gross alpha received a "not acceptable" and a second test received an "acceptable with warning." The third test and all gross beta tests were acceptable.

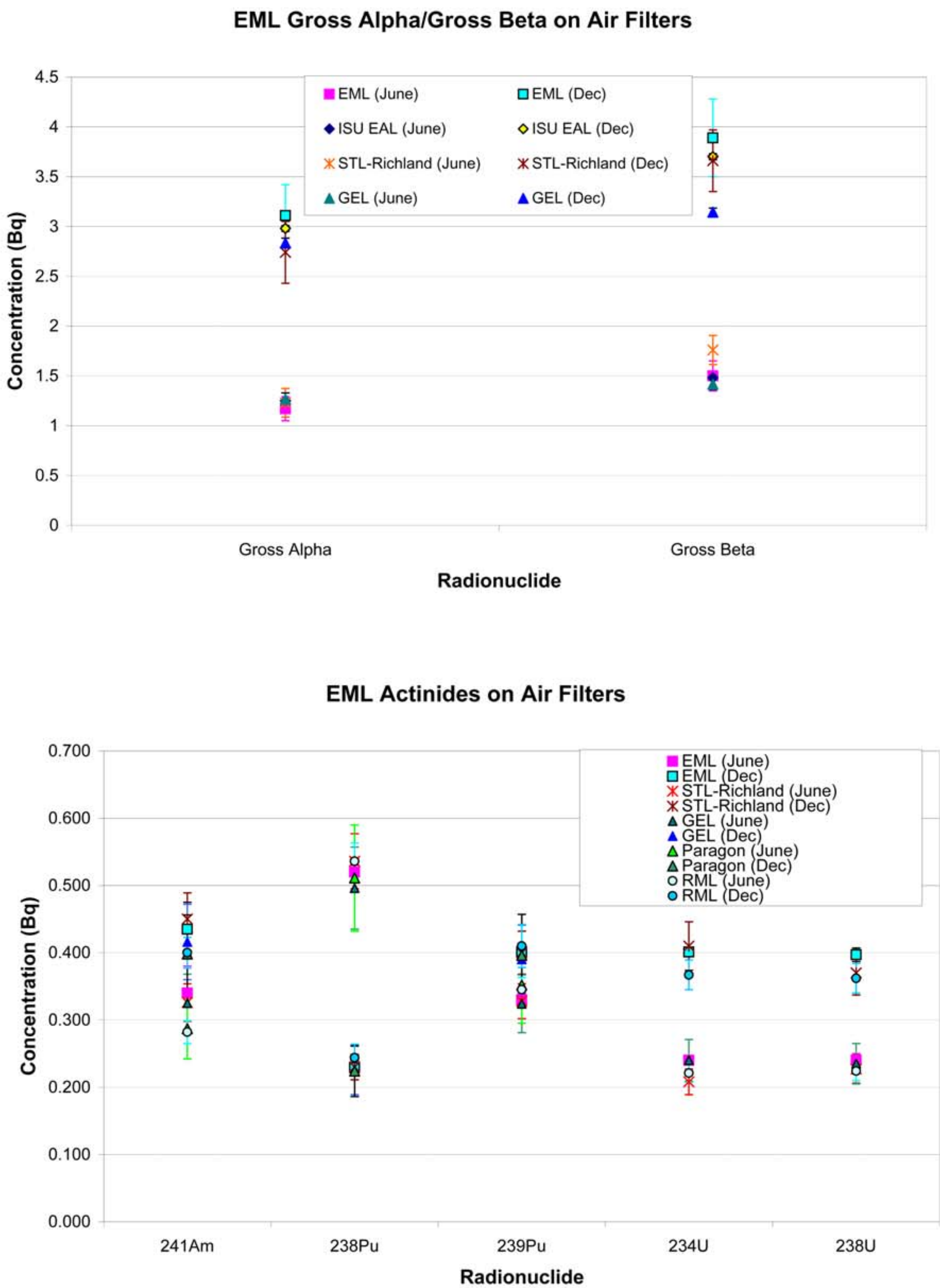
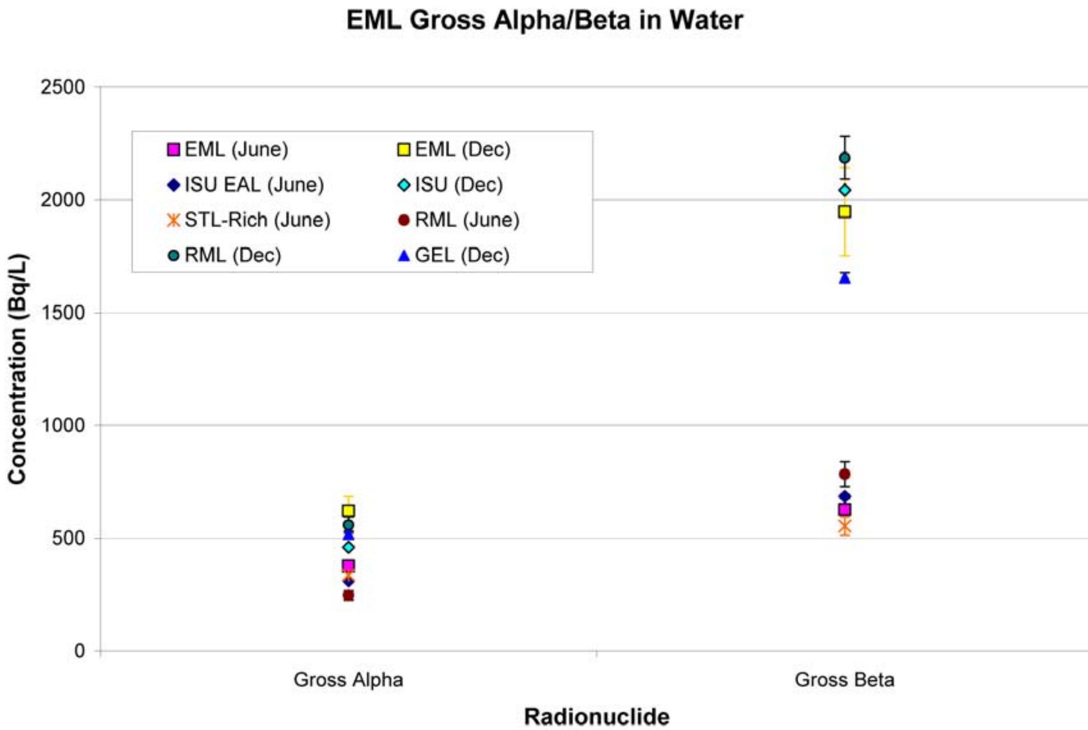


Figure 10-1. Surveillance contractor laboratory air sampling results from the EML intercomparison (2003).



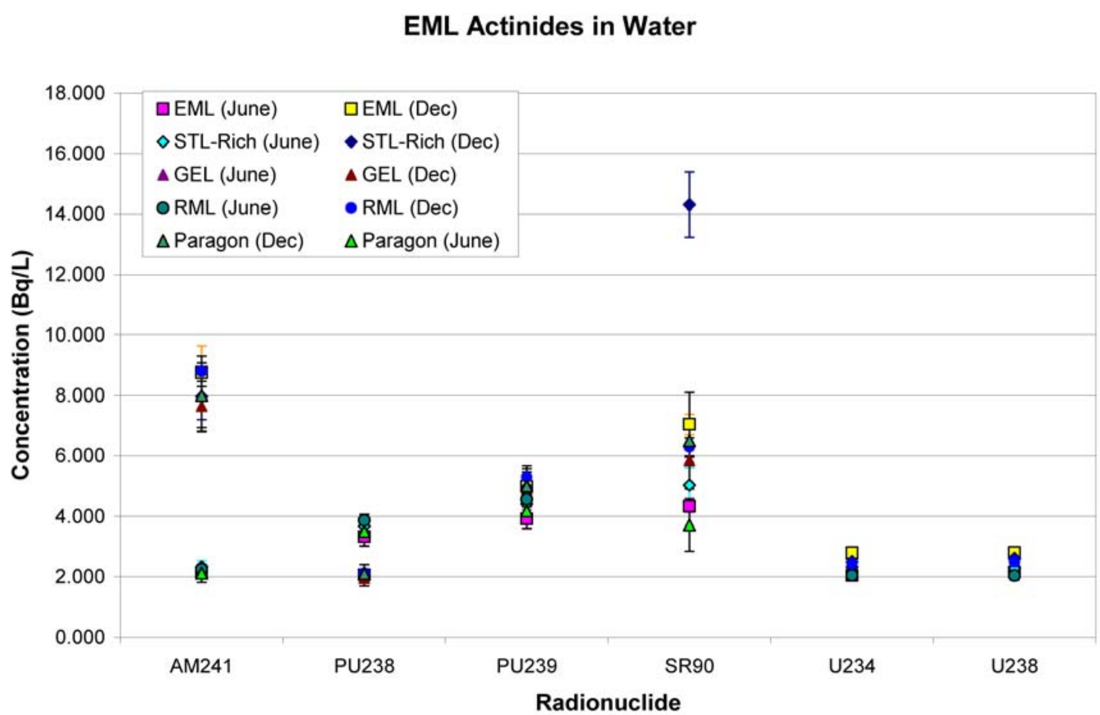


Figure 10-2. Surveillance contractor laboratory water sampling results from the EML intercomparison (2003).

National Institute of Standards and Technology

The DOE RESL participates in a traceability program administered through the National Institute of Standards and Technology (NIST). RESL prepares requested samples for analysis by NIST to confirm their ability to adequately prepare sample material to be classified as NIST traceable. NIST also prepares several alpha-, beta-, and gamma-emitting standards, generally in liquid media, for analysis by RESL to confirm their analytical capabilities. RESL maintained NIST certifications in both preparation and analysis in 2003.

Dosimetry

To verify the quality of the environmental dosimetry program conducted by the M&O contractor, the Operational Dosimetry Unit participates in International Environmental Dosimeter Intercomparison Studies. The Operational Dosimetry Unit's past results have been within ± 30 percent of the test exposure values on all intercomparisons. This is an acceptable value that is consistent with other analysis that range from ± 20 percent to ± 35 percent. During 2003, the International Environmental Dosimeter Intercomparison Study was not offered for participation.

The Operational Dosimetry Unit of the INEEL M&O Contractor also conducts in-house quality assurance testing during monthly and quarterly environmental thermoluminescent dosimeter (TLD) processing periods. The quality assurance (QA) test dosimeters were prepared by a QA program administrator. The delivered irradiation levels were blind to the TLD processing technician. The results for each of the QA tests have remained within the 20 percent acceptance criteria during each of the testing periods during calendar year 2003. At no time during QA testing did any test exceed ± 10 percent.

Other Programs

INEEL contractors participate in additional performance evaluation programs, including those administered by the International Atomic Energy Agency, the U.S. Environmental Protection Agency (EPA), and the American Society for Testing and Materials. Contractors are required by law to use laboratories certified by the State of Idaho or certified by another state whose certification is recognized by the State of Idaho for drinking water analyses. The Idaho State Department of Environmental Quality oversees the certification program and maintains a listing of approved laboratories. Where possible (i.e., the laboratory can perform the requested analysis) the contractors use such state-approved laboratories for all environmental monitoring analyses.

10.3 Data Precision and Verification

As a measure of the quality of data collected, the ESER contractor, the M&O contractor, the USGS, and other contractors performing monitoring use a variety of quality control samples of different media. Quality control samples include blind spike samples, duplicate samples, and split samples.

Blind Spikes

Groups performing environmental sampling use blind spikes to assess the accuracy of the laboratories selected for analysis. Contractors purchase samples spiked with known amounts of radionuclides or nonradioactive substances from suppliers whose spiking materials are traceable to the NIST. These samples are then submitted to the laboratories with regular field samples, with the same labeling and sample numbering system. The analytical results are expected to compare to the known value within a set of performance limits.

Duplicate Sampling within Organizations

Monitoring organizations also collect a variety of quality control samples as a measure of the precision of sampling and analysis activities. One type is a duplicate sample, where two samples are taken from a single location at the same time. A second type is a split sample, where a single sample is taken and later divided into two portions that are analyzed separately. Contractors specify in quality assurance plans the relative differences expected to be achieved in reported results for both types of quality assurance samples.

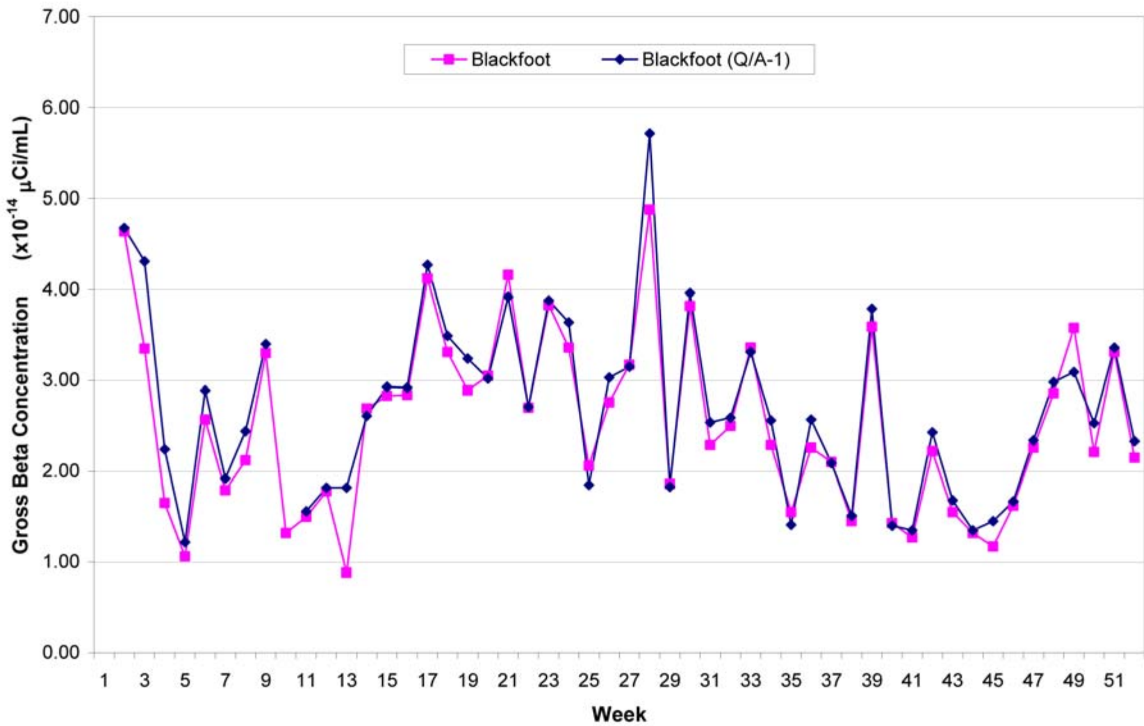
Both the ESER contractor and the M&O contractor maintained duplicate air samplers at two locations during 2003. The ESER contractor operated duplicate samplers at the locations in Blackfoot and Mudlake. The M&O contractor duplicate samplers were located at Argonne National Laboratory-West (ANL-W) and at the Van Buren Boulevard Gate. Filters from these samplers were collected and analyzed in the same manner as filters from regular air samplers. Graphs of gross beta activity for the duplicate samplers are shown in Figures 10-3 and 10-4.

Duplicate Sampling between Organizations

Another measure of data quality can be made by comparing data collected simultaneously by different organizations. The ESER contractor, the M&O contractor, and the State of Idaho's INEEL Oversight Program collected air monitoring data throughout 2003 at four common sampling locations: the distant locations of Craters of the Moon National Monument and Idaho Falls, and on the INEEL at the Experimental Field Station and Van Buren Boulevard Gate. Comparisons of data from these sampling locations for gross beta are shown in Figure 10-5.

The ESER contractor collects semiannual samples of drinking and surface water jointly with the INEEL Oversight Program at five locations in the Magic Valley area and two shared locations near the INEEL. Table 10-1 contains intercomparison results of the gross alpha, gross beta, and tritium analyses for the 2003 samples taken from these locations.

The USGS routinely collects groundwater samples simultaneously with the INEEL Oversight Program. Comparison results from this sampling are regularly documented in reports prepared by the two organizations.



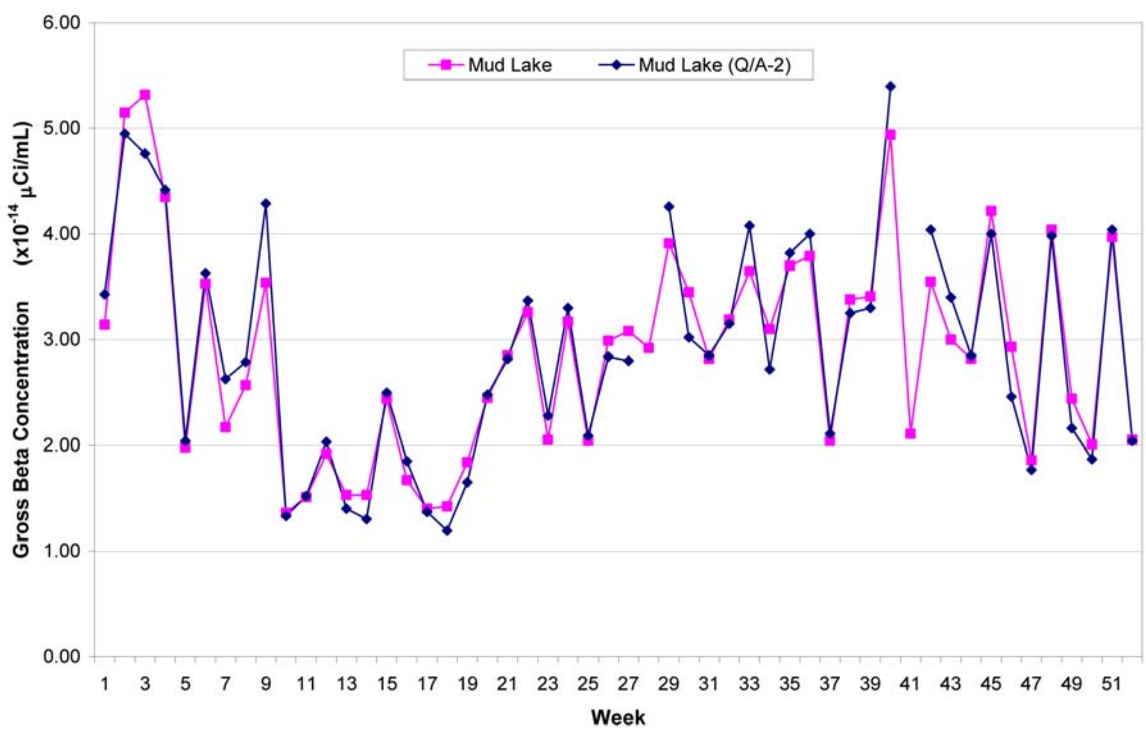
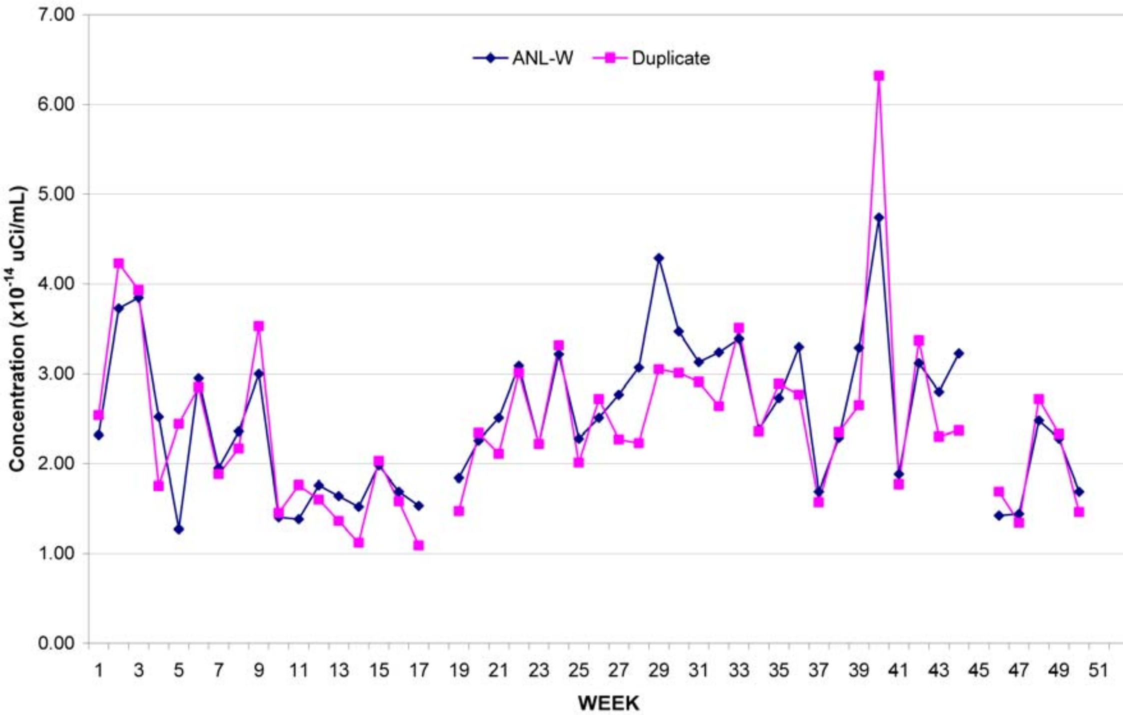


Figure 10-3. ESER contractor duplicate air sampling gross beta results (2003).



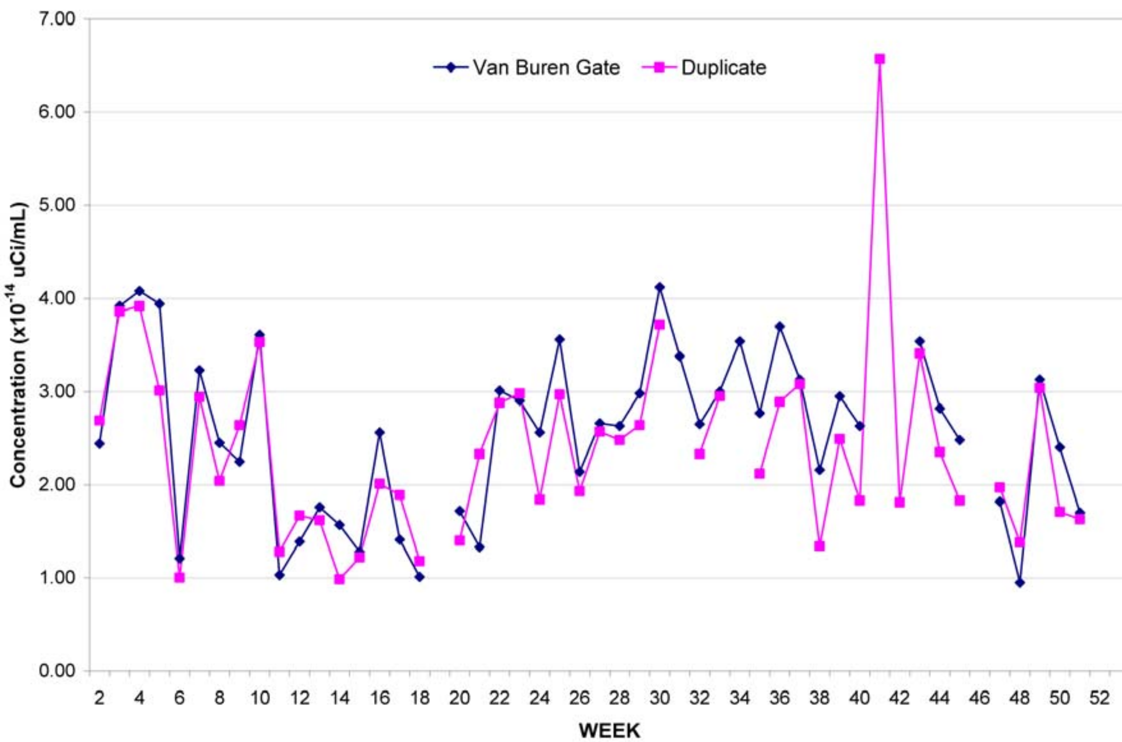


Figure 10-4. M&O contractor duplicate air sampling gross beta results (2003).

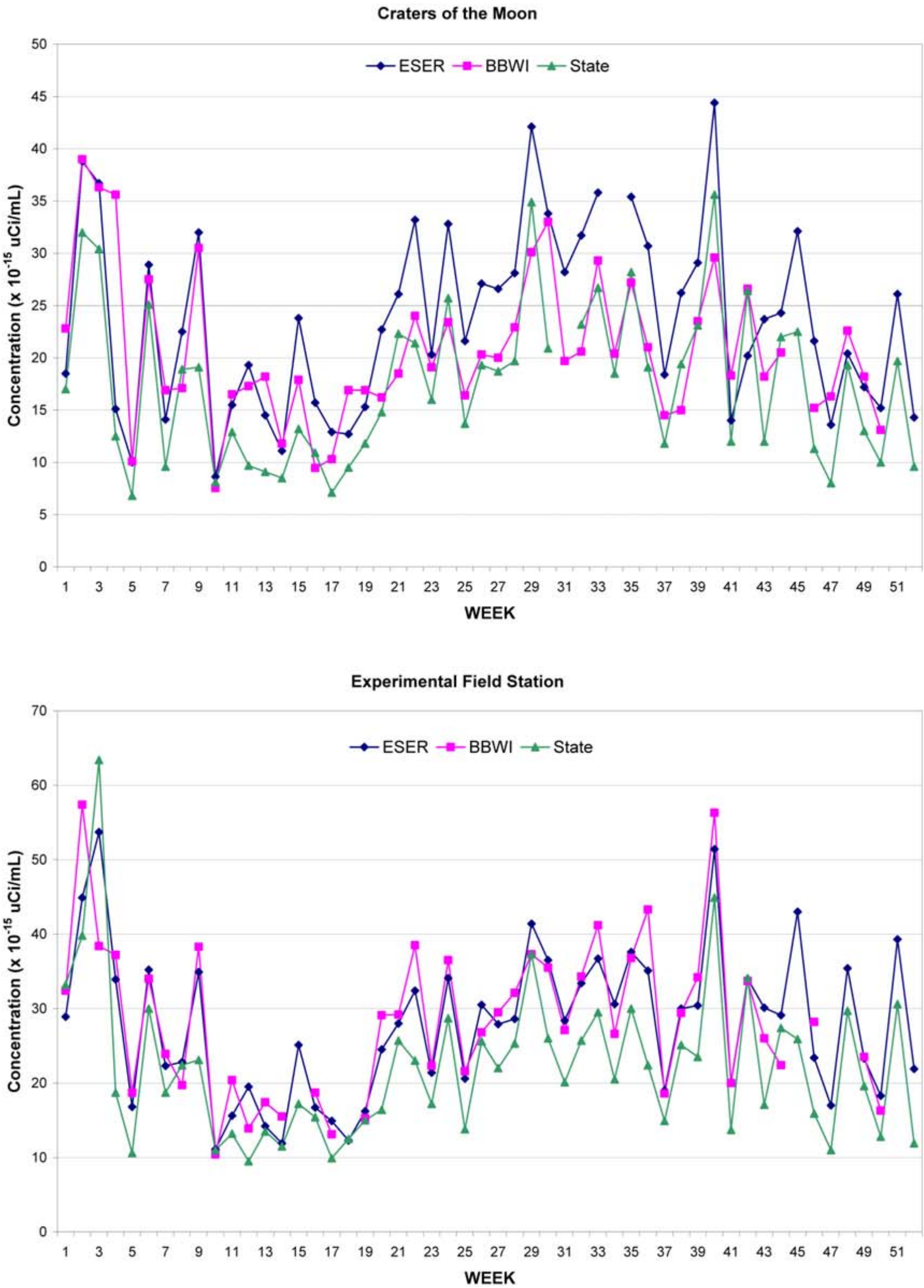
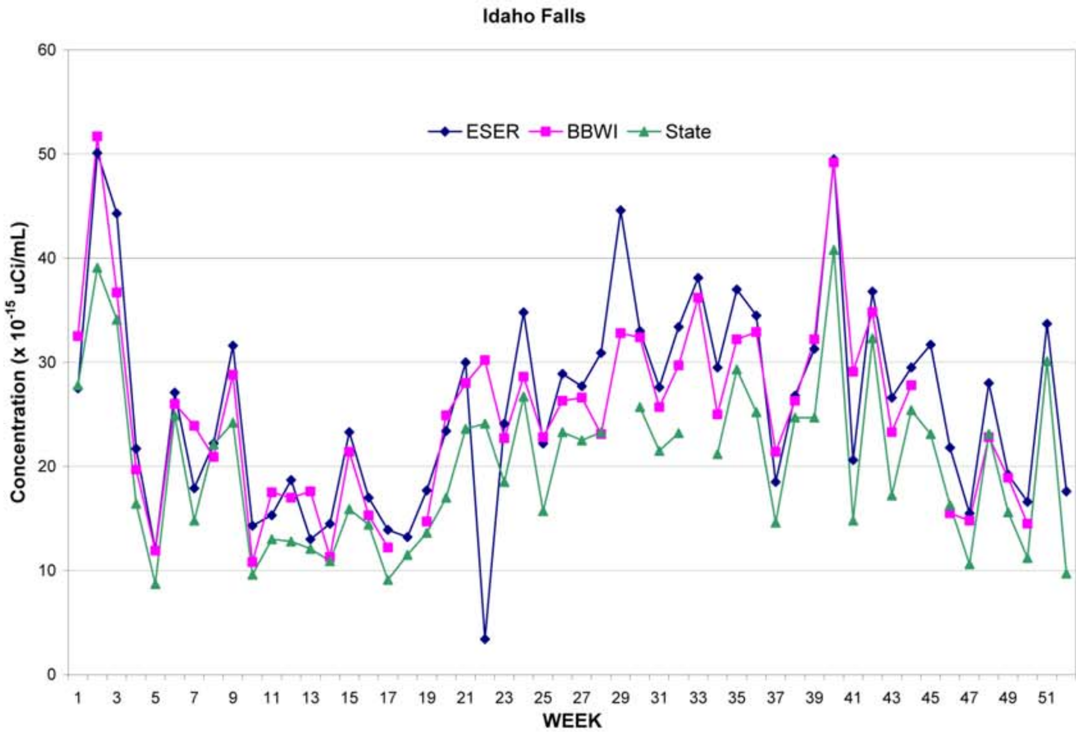


Figure 10-5. Comparison of gross beta concentrations measured by ESER contractor, M&O contractor, and State of Idaho (2003).



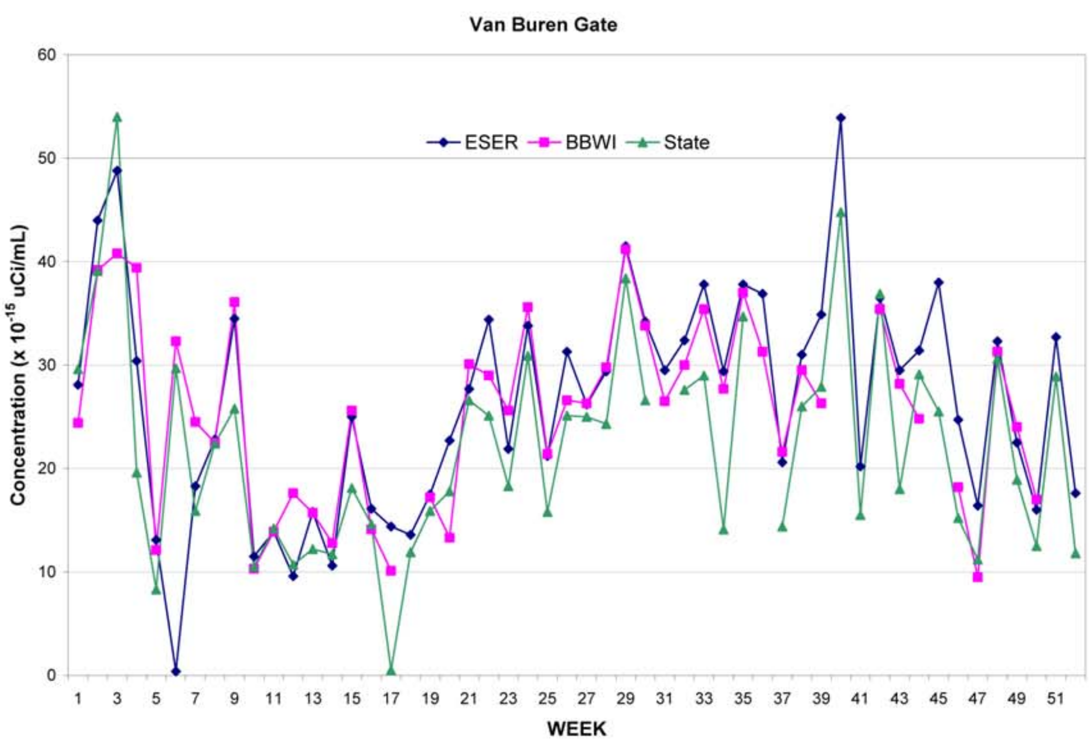


Figure 10-5. Comparison of gross beta concentrations measured by ESER contractor, M&O contractor, and State of Idaho (2003). (continued)

Table 10-1. Comparison of ESER and INEEL Oversight Program water monitoring results (2003).[a]

Location	Date	Gross Alpha (pCi/L) ESER	Gross Alpha (pCi/L) State	Gross Beta (pCi/L) ESER	Gross Beta (pCi/L) State	Tritium (pCi/L) ESER	Tritium (pCi/L) State
Drinking Water							
Atomic City	05/14	0.37 ± 0.8	1.1 ± 1.6	3.3 ± 1.6	1.5 ± 0.9	-66.9 ± 119.0	0 ± 60
	11/13	-0.2 ± 0.6	1.7 ± 2.1	2. 9 ± 1.7	2.9 ± 1.0	54.3 ± 111.0	-30 ± 70
Minidoka	05/14	-0.2 ± 0.7	-0.2 ± 1.2	3.6 ± 1.7	1.5 ± 0.7	-72.0 ± 117.0	10 ± 60
	11/13	0.7 ± 0.9	0.4 ± 2.9	3.9 ± 1.8	1.8 ± 1.2	134.0 ± 112.0	-30 ± 70
Mud Lake	05/14	-0.02 ± 0.5	1.1 ± 1.2	1.0 ± 1.4	2.4 ± 0.8	-30.5 ± 114.0	-90 ± 70
	11/13	-0.01 ± 0.6	-0.6 ± 1.2	5.4 ± 1.8	3.0 ± 0.9	22.5 ± 44.6	-40 ± 70
Shoshone	05/14	0.04 ± 0.7	0.3 ± 1.6	4.1 ± 1.7	2.1 ± 1.0	44.1 ± 45.9	10 ± 60
	11/13	1.3 ± 1.0	2.0 ± 1.7	2.2 ± 1.7	1.6 ± 0.8	33.2 ± 45.2	80 ± 70
Surface Water							
Buhl	05/13	0.0 ± 0.8	0.7 ± 1.4	4.5 ± 1.8	1.8 ± 0.9	-16.6 ± 44.3	65 ± 49
	11/12	-0.2 ± 0.7	2.6 ± 2.7	3.1 ± 1.8	1.9 ± 1.1	0.9 ± 46.3	20 ± 49
Hagerman	05/13	1.5 ± 1.0	2.8 ± 1.5	2.2 ± 1.7	1.7 ± 0.9	-27.8 ± 43.8	60 ± 70
	11/12	1.1 ± 0.9	0.3 ± 1.8	4.6 ± 1.8	1.1 ± 1.0	16.5 ± 44.9	-10 ± 70
Twin Falls	05/13	0.6 ± 1.0	0.9 ± 1.8	5.3 ± 1.9	3.8 ± 1.0	36.5 ± 44.8	70 ± 70
	11/12	-0.1 ± 0.7	1.8 ± 2.8	7.1 ± 2.1	5.1 ± 1.2	94.7 ± 50.6	100 ± 70

a. Values are shown as the result ± 2 standard deviations, where the standard deviation is the total uncertainty.

10.4 Program Quality Assurance

Liquid Effluent Program Quality Assurance/Quality Control

The M&O contractor's Liquid Effluent Monitoring Program has specific quality assurance/quality control objectives for monitoring data. Goals are established for accuracy, precision, and completeness, and all analytical results are validated following standard EPA protocols. This section applies to all surveillance groundwater and effluent monitoring.

Performance evaluation samples (submitted as field blind spikes) are required to assess analytical data accuracy. At a minimum, performance evaluation samples are required quarterly.

During 2003, four quarterly sets of performance evaluation samples were submitted to the laboratory along with routine monitoring samples. With the exception of antimony, no blind spike parameters routinely missed the performance acceptance limits. Out of two field blind spikes submitted for antimony, both exceeded the upper performance acceptance limit (the laboratory value was higher than the true value). For blind spike results above the performance acceptance limit, the concern is that all the reported concentrations associated with that blind spike result could be biased in the same direction and could result in the appearance of a permit limit exceedance when in fact none has occurred. For blind spike results that fall below the performance acceptance limit, the concern is that all the associated reported concentrations could again be biased in the same direction as the blind spike results and could result in an unreported exceedance of a permit limit. A review of the reported concentrations for all blind spike parameters that fell below the performance acceptance limit showed that there were no impacts to regulatory limits.

Relative percent difference (RPD) between the duplicate samples is used to assess data precision. Table 10-2 shows the results for 2003.

Table 10-2. RPD results.

Parameter	RPD Result
Inorganic and metals	92% within the program goal of less than or equal to 35%.
Radiological parameters	Only one set of duplicate results had detectable quantities. The RPD for that set of duplicates was < 13.75%, which met the program goal of less than or equal to 35%.

Note: The RPD is only calculated if both results are detected (greater than instrument detection limit).

The goal for completeness is to collect 100 percent of all required compliance samples. During the 2003 year, this goal was met.

Validation performed on analytical results from the 2003 sampling efforts resulted in one rejected sample:

- The June total dissolved solids result for CFA-689 was rejected for exceeding the hold time.

No other sampling or validation issues were identified during calendar year 2003.

Wastewater Land Application Permit Groundwater Monitoring Quality Assurance/Quality Control

The groundwater sampling activities associated with Wastewater Land Application Permit compliance sampling follow established procedures and analytical methodologies.

During 2003, groundwater samples were collected from all of the Idaho Nuclear Technology and Engineering Center (INTEC) and Test Area North (TAN) Wastewater Land Application Permit monitoring wells (with the exception of perched Well ICPP-MON-V-191 which was dry during both April 2003 and October 2003). All of the samples required for permit compliance were collected and none of the analytical results were rejected as unusable during data validation.

Field quality control samples were collected or prepared during the sampling activity in addition to regular groundwater samples. Laboratories qualified by the INEEL Sample and Analysis Management Organization performed all M&O wastewater and groundwater analyses during 2003. Because TAN and INTEC are regarded as separate sites, quality control samples (duplicate samples, field blanks, and equipment blanks) were prepared for each site.

Duplicate samples are collected to assess the potential for any bias introduced by analytical laboratories. One duplicate groundwater sample was collected for every 20 samples collected or, at a minimum, 5 percent of the total number of samples collected. Duplicates were collected using the same sampling techniques and preservation requirements as regular groundwater samples. Duplicates have precision goals within 35 percent as determined by the relative percent difference measured between the paired samples. In 2003, for the 36 duplicate pairs with detectable results, 94 percent had RPDs less than 35 percent. This high percentage of acceptable duplicate results indicates little problem with laboratory contamination and good overall precision.

Field blanks are collected to assess the potential introduction of contaminants during sampling activities. The field blanks were collected at the same frequency as the duplicate samples. Results from the field blanks did not indicate field contamination. Equipment blanks (rinsates) were collected to assess the potential introduction of contaminants from decontamination activities. The equipment rinsates were collected by pouring analyte-free water through the sample port manifold after decontamination and before subsequent use. Again, results from the equipment blanks did not indicate improper decontamination procedures.

Results from the duplicate, field blank, and equipment blank (rinsate) samples indicate that laboratory procedures, field sampling procedures, and decontamination procedures were used effectively to produce high quality data.

Storm Water Monitoring Quality Assurance/Quality Control

The two samples collected at the Radioactive Waste Management Complex and the two samples collected at the T-28 north gravel pit were collected as unfiltered grab samples. No trip blanks or duplicate samples were collected. Sample containers and preservation methods were used according to internal procedures. The data were reviewed according to internal procedures.

Visual examination reports were checked for accuracy against logbook entries before submittal to the industrial storm water coordinator.

Drinking Water Program Quality Assurance/Quality Control

The Drinking Water Program's completeness goal is to collect, analyze, and verify 100 percent of all compliance samples. This goal was met during 2003.

The Drinking Water Program requires that 10 percent of the samples (excluding bacteria) collected be quality assurance/quality control samples to include duplicates, field blanks, trip blanks, blind spikes, and splits. This goal was met in 2003 for all parameters.

The Drinking Water Program's precision goal states that the relative percent difference determined from duplicates must be 35 percent or less for 90 percent of all duplicates. That goal was met for 2003, with 90 percent of the relative percent differences calculated from a sample and its duplicate being less than the required 35 percent (for those with both results detected). Relative percent difference was not calculated if either the sample or its duplicate were reported as nondetects.

Environmental Surveillance Program Quality Assurance/Quality Control

The M&O contractor analytical laboratories analyzed all Environmental Surveillance Program samples as specified in the statements of work. These laboratories participate in a variety of intercomparison quality assurance programs, which verify all the methods used to analyze environmental samples. The programs include the DOE EML QA Program and the EPA National Center for Environmental Research (NCER) QA Program. The laboratories met the performance objectives specified by the EML and NCER.

The Environmental Surveillance Program met its completeness goals. Samples were collected and analyzed as planned from all available media. The Waste Management Surveillance Program submitted duplicate, blank, and control samples as required with routine samples for analyses.

On October 1, 2003, the M&O's Environmental Services Project changed laboratories for the analysis of ambient air, soils, and biota samples. As of the time of this report, the laboratory's performance is under review for accuracy of the data. This review is being conducted because of inconsistencies with previous years' data.

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